Demand Response Research Center

Client and Logic with Integrated Relay User Guide: Installation and Troubleshooting for Auto-DR

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Purpose:

This user guide is intended to introduce and guide "Technical Coordinators (TC)" of Automated Demand Response (AutoDR) systems through pre (before visiting a facility) and post (at the facility) install procedures for the Client and Logic with Integrated Relay (CLIR) and to receive remote signals from Utility's Demand Response Automation Server (DRAS). These signals facilitate a response to Utility's Automated Demand Response (AutoDR) program services such as Critical Peak Pricing (CPP), Demand Bidding Program (DBP), and other related program services. These install procedures will enable CLIR as an interface device for these programs.

In addition to notifications such as pager alerts and e-mails, the CLIR enables sites equipped with this AutoDR technology to receive signals over the Internet to trigger pre-programmed demand response strategies and reduce peak electric loads. This user guide does not cover the Energy Management Control Systems (EMCS) programming for DR strategies or signals to facility's HVAC or lighting systems or other environmental controls. The other form of receiving signals from DRAS using the "DRAS Software-Client" (or Web Service Client) is also not covered in this document.

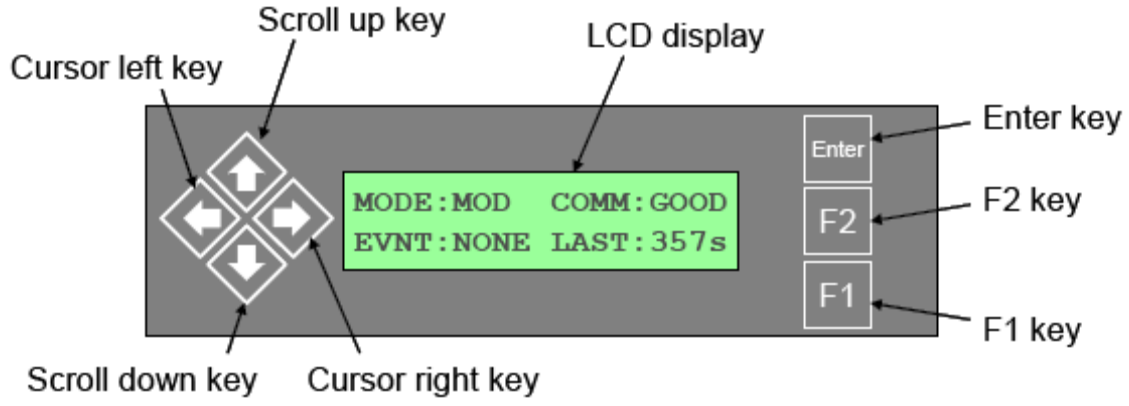
Introduction to CLIR:

The CLIR is a secure, self-configuring Internet relay. The CLIR enables the EMCS to receive AutoDR signals over the Internet. These signals are translated into relay contacts that are sensed by the EMCS. The EMCS causes the facility to automatically enter preconfigured low energy modes through modifications to the HVAC, lighting systems, etc. during the AutoDR event.

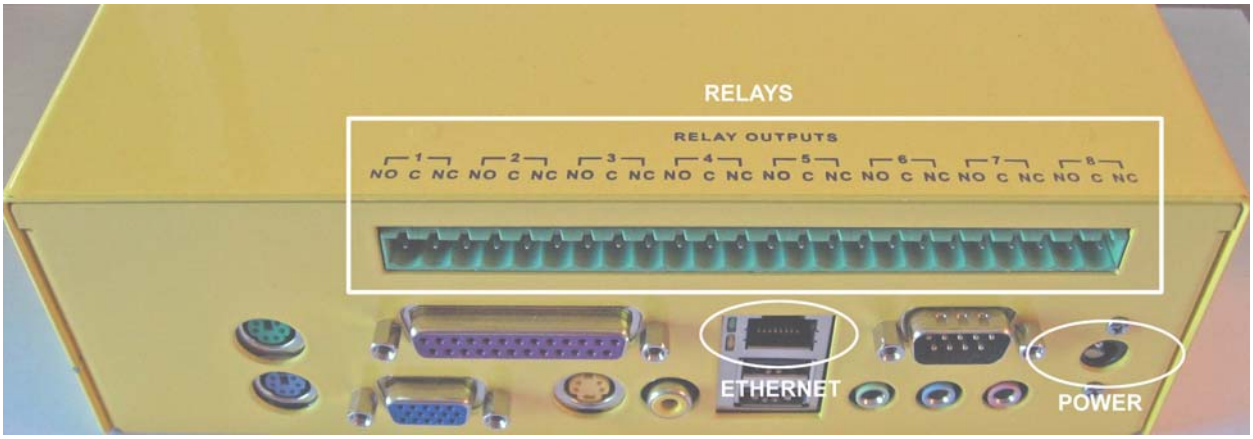
Once powered on, the status of the CLIR Box is visible via a LCD display. Internet connectivity, time since last successful communication with the server, event modes and other relevant data is shown. An integrated keypad allows installers of the CLIR box to set all relevant configurations without the use of a laptop or remote terminal. Parameters such as static IP address, DHCP, and proxy server address can be configured using the keypad. The complete minimum list of all CLIR parameters is shown in "Appendix A.1 or Table 1" and "Appendix A.2 or Table 2." The CLIR specifications are detailed in Appendix A.3.

Buttons, Display, and Connectors:

The front of the CLIR has 7 buttons and an LCD display which can be used to enter configuration information and inspect the status as shown in the figure. More details are shown in Appendix B.



The back of the CLIR has the connectors for power, Ethernet, and relays to control the EMCS:



- The power connector accepts an input of 12 VDC from the supplied power adapter.
- The Ethernet connector accepts a RJ-45 10/100BaseT cable.
- The 8 relays are connected using the supplied removable screw terminals. The relays supports both normally open (NO) and normally closed (NC) connections. The center pin of each terminal is common (C). The labeling on the top of CLIR indicates the function of each terminal.

None of the other are connectors are used presently.

Event Pending Signal:

The DRAS communicates to the CLIR whether a DR event is pending (upcoming) for the facility. This signal is either day-ahead or day-of and can be used by the EMCS in addition to the event mode signals for functions such as pre-cooling, preparing the loads for reduction, etc. This signal is reflected on relay 3 on CLIR as shown in the table below assuming a normally open connection is used (Note: If normally closed connections are used, the logic should be reversed):

Relay	Event Not Pending	Event Pending
3	open	closed

Note that the event pending signal can be sent any time on the day-ahead or the day-of the event (check with the DRAS operator and/or technical coordinator for further details on this time frame for specific AutoDR program). The signal will go off (normal-level) after the event is over.

Event Mode Signal:

The DRAS communicates three different DR event modes to the CLIR – normal, moderate, and high. The EMCS in the facility is programmed to respond to either or all of these three event modes based upon the state of the relays 1 and 2 on the CLIR and AutoDR program(s). The table below shows the states of the relays for each event mode assuming normally open connections are used (Note: If normally closed connections are used, the logic should be reversed):

Relay	Normal Shed	Moderate Shed	High Shed
1	open	closed	closed
2	open	open	closed

CLIR End-Point DRAS Server Name:

The *servername* for CLIR end-point host depends on the electrical utility territory servicing the participant's facility and is to be configured as follows:

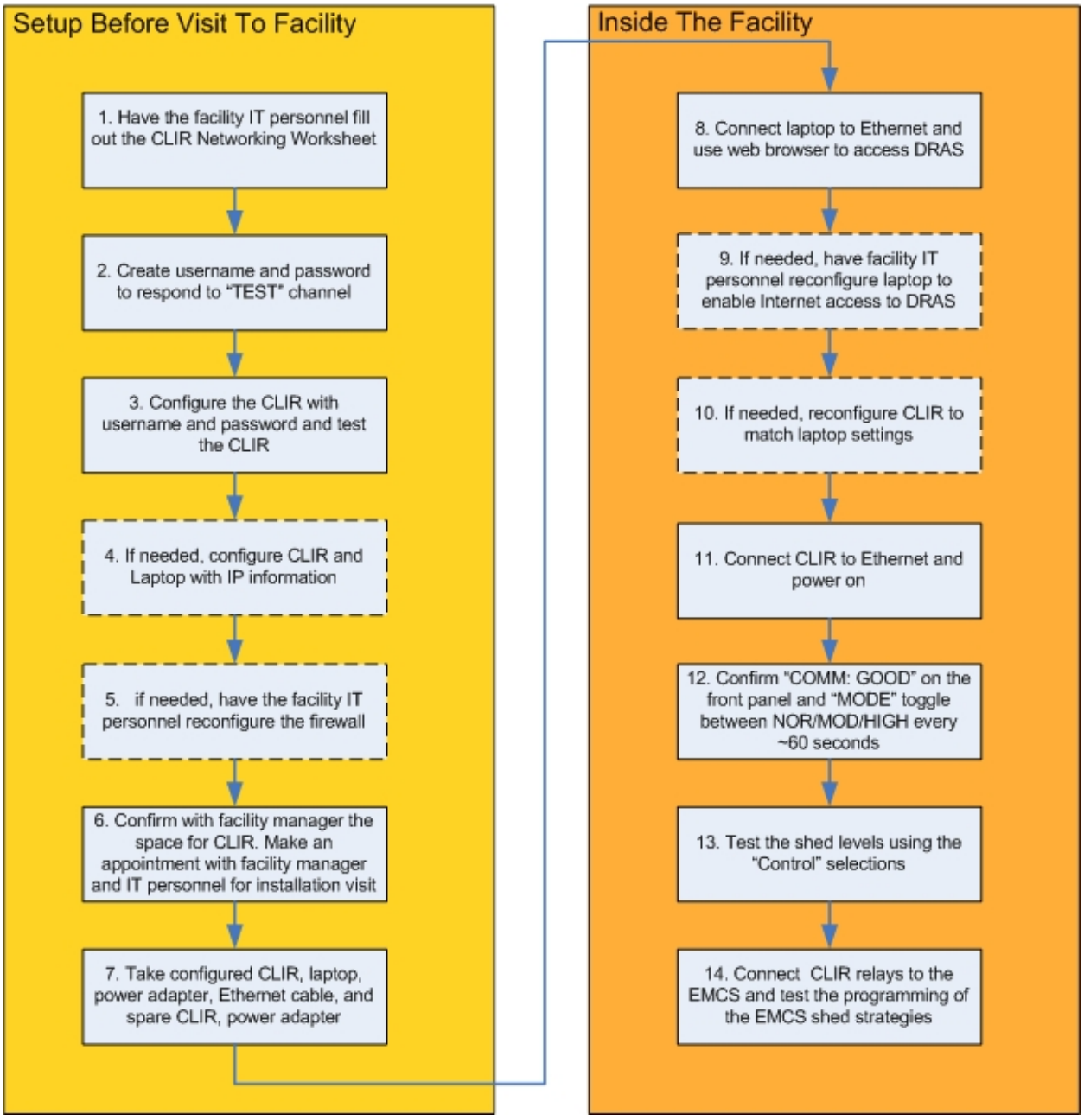
- Pacific Gas & Electric (PG&E) - *pge.openadr.com*
- Southern California Edison (SCE) - *sce.openadr.com*
- San Diego Gas & Electric (SDG&E) - *sdge.openadr.com*

CLIR Security:

CLIR Box is "IT Friendly". It is typically installed inside of the secure enterprise network and "polls" for CPP event information using 128 bit Secure Socket Layer (SSL) encryption using Secure Hyper Text Transfer Protocol (HTTPS). HTTPS is generally accepted Internet standard, also used for most financial transactions. No modification to corporate enterprise firewalls is required. Since the CLIR Box only polls outside network, it is not accessible from the public Internet and adds no security risk from outside the private network. The CLIR Box is also secure from internal threats (employees, contractors etc.) due to its internal firewall which filters out all messages except those from the LBNL DRAS. The CLIR firewall also protects it if the box is installed outside of the private network on the "De-Militarized Zone (DMZ)". The CLIR Box is password protected and uses (SSL) encryption for all network communications.

Optionally, for those who need additional security and use a firewall to regulate Internet traffic. The firewall can be configured to deny all outgoing communications from the CLIR except for HTTPS access to the utility's DRAS <*servername*> and DNS access to 206.13.28.12, 206.13.31.12, and 206.13.29.12. All incoming communications to the CLIR can be blocked.

CLIR setup and installation flowchart:



CLIR setup before visiting the facility:

1) Have the facility IT personnel fill out the "CLIR Networking Worksheet" (see appendix F).

2) Create a **`username`** and secure **`password`** (8 or more characters long including at least one number or symbol) for the CLIR and communicate it to the DRAS operator. Note that this same username and password is used to access the My Site page.

3) If you have access to a DHCP network with no proxy server and outgoing firewall restrictions, test that the CLIR can connect to the DRAS using the username and password as follows:

   a) Connect CLIR to the Ethernet port and plug in the power connector.

b) Wait until the CLIR boots up, enter the username and password. Refer to Appendix B for description on using the CLIR keypad and display.
c) You should see "**COMM: GOOD"** on the CLIR display. If not, contact the DRAS operator.

4) If the subnet where the CLIR is to be connected does not have DHCP or requires a Proxy Server, configure the CLIR and dedicated laptop with prior to arriving at the facility.

   a) Does the subnet where CLIR is connected require static IP address configuration (no DHCP)? If yes, CLIR attributes have to be configured. Enter the information obtained from the "Worksheet – Reference 1" to CLIR. CLIR attributes to be configured are – Static IP address (`netIPAddress` and `DHCP=n`), Default Gateway (`netGatewayAddress`), Subnet Mask (`netSubnetMask`), Preferred and Alternate DNS are needed only for laptop to connection inside facility's network.
   b) Does the subnet require a "Proxy Server" to access HTTPS sites? If yes, more CLIR attributes have to be configured from information in the "Worksheet – Reference 2." CLIR attributes to be configured are – Proxy Server IP (`netProxyIPAddress` and `netProxyServer=y`), Proxy port (`netProxyPort`).
   c) Details on configuring the dedicated laptop are explained in Appendix D.x.

5) If the subnet where the CLIR is to be connected does not have HTTPS or DNS access, the firewall must be reconfigured by the facility IT personnel to provide this access.

6) Confirm with the facility manager that there is physical space to mount the CLIR and connect its power supply, network cables, and relay connections and schedule an appointment w/ facility manager and IT personnel at same time for a visit.

7) Take the pre-configured dedicated laptop, Ethernet (RJ 45) cable, and an extra CLIR box and power adapter to the facility.

At The Facility:

8) Connect the configured laptop to the Ethernet port to be used by CLIR and use a web browser to access the DRAS (https://<utility>.openadr.com/pss2.website) where <utility> is ether "pge" (PG&E), "sce" (SCE), or "sdg" (SDG&E).

9) If the laptop can't access the DRAS log in page, hand in the laptop to IT personnel and ask it to be reconfigured so that Internet access to DRAS is possible.

10) If the laptop was reconfigured by the IT personnel in step 10 above, reconfigure the CLIR to match the new laptop settings.

11) Connect CLIR to the Ethernet port and plug in the power connector and wait until the CLIR boots up (this takes about 2 minutes).

12) Confirm that "**COMM: GOOD"** appears on the front panel of the CLIR. If not, confirm the laptop settings to CLIR attributes and try again. Note that the "Mode:" on the front panel may toggle between NOR/MOD/HIGH every 60 seconds or so if the CLIR has been assigned to a test program by the DRAS operator

13) Use another live Internet connection to connect to the DRAS My Site page using the username and password and test the event modes from the following available controls and

confirm if CLIR responds to following event mode of operations and test if the relays on the back of CLIR are correct (see Appendix E for details):

a) Opt Out - For facilities to override Utility's load reduction signals - **MODE: NORM**
b) Forced Moderate – Moderate CPP rate – **MODE: MOD**
c) Forced High – Highest CPP rate – **MODE: HIGH**

Note: Make sure to set the control back to Auto-CPP when this test is completed.

14) Connect the CLIR relays to the EMCS and program the EMCS DR load reduction strategies. Please be aware that in "test" channel the levels toggle between normal/moderate/high when on "AutoDR" mode. See Appendix C for an example.

Note: Please coordinate with Facility Mangers and programmers and clearly communicate the different relay signals, its functions, and relevant actions to be taken for enabling automation and DR strategies.

Contact:

- GEP | gepop@gepllc.com | 925.284.3780
- Akuacom | info@akuacom.com
- LBNL | Demand Response Research Center (DRRC) | AutoDR@lbl.gov

The most recent version of this user-guide is available on – http://www.auto-dr.com

Appendices:

Appendix A.1: Table 1 – LCD Display – Terms and Definitions

CLIR Front Panel Display	Attribute	Description

Display Page 1
`MODE:NORM COMM:GOOD`
`EVNT:NONE LAST:43s`
	MODE	Current shed mode of operation.
		NORM = No shed (Normal)
		MOD = Moderate shed mode (moderate CPP rate)
		HIGH = High shed mode (highest CPP rate)

	COMM	Communication status between CLIR and DRAS. GOOD or BAD.
	EVNT	AutoCPP/AutoDBP event indication. NONE = No upcoming event pending PEND = Event is pending or there is an event in progress.
	LAST	Time duration since the last successful communication between the CLIR and DRAS.

Display Page 2
`IP:128.2.32.154`
`UP:0d 12h 08m 01s`
	IP	IP address of CLIR. The IP address may be automatically assigned by a DHCP server or manually assigned. If the CLIR Box does not have a valid IP address, "IP: Cable?" will be shown. This indicates that either 1) Ethernet cable not connected 2) DHCP server not available on network or 3) Static IP address has not been assigned.

	UP	Time duration since CLIR was last booted.

Display Page 3
`CLIR R:12345678`
`VER:2.4 10010000`
	CLIR VER	Version of CLIR box.

	R	Status of relays (R1-R8). 0 = Relay de-energized 1 = Relay energized (i.e. normally open contact is closed)

Display Page 4
`SUCC: 27 FAIL: 0`
`AVE:247 MAX:675`
	SUCC	Number of successful communications since start.

	FAIL	Number of communication failures since start.
	AVE	Average communication latency in milliseconds.
	MAX	Maximum communication latency in milliseconds.

Appendix A.2: Table 2 – F2 Setting Menu

Attribute	CLIR Default Settings	Description
consoleLogLevel	INFO	Do not change.
endPointHost	[utility DRAS host]	Do not change.
endPointPath	PSS2WS/PSS2WS	Do not change.
endPointPort	443	Do not change.
fileLogLevel	INFO	Do not change.
ipAddressFile	/usr/clir/eth0-ipaddress	Do not change.
logFile	/usr/clir/clir.log	Do not change.
netDHCP	**y**	If "y", CLIR automatically obtains IP address from DHCP server. Change to "n" if a static IP address is used.
netGatewayAddress	**192.168.1.1**	Default Gateway. If "netDHCP" is "n", the manually entered static IP address is used as default gateway.
netIPAddress	**192.168.1.99**	CLIR Box IP address. If "netDHCP" is "n", the manually entered static IP address is used as IP address for the CLIR Box.
netProxyIPAddress	**192.168.1.2**	If "netProxyServer" is "y", the manually entered static IP address is used as IP address for the proxy server on your network.
netProxyPort	**8080**	Port of proxy server access. If "netProxyServer" is "y", enter IP port of proxy server on your network. Note that the CLIR uses SSL, so this should be the https port.
netProxyServer	**n**	If "y", CLIR accesses to proxy server.
netSubnetMask	**255.255.255.0**	If "netDHCP" is "n", use this IP address for subnet mask.
noLCD	n	Do not change.
noRelay	n	Do not change.
password	**test**	Change to the password you received.
pollPeriodMS	**60000**	Do not change. Frequency of polling activity. Default 60,000 milliseconds indicate 1 poll per minute.
ssl	y	Do not change.
statsLoggingPeriodMS	60000	Do not change.
trustStore	/usr/clir/cacerts.jks	Do not change.
trustStorePassword	epriceLBL	Do not change.
username	**test**	Change to the username you received.

Appendix A.3: CLIR specifications

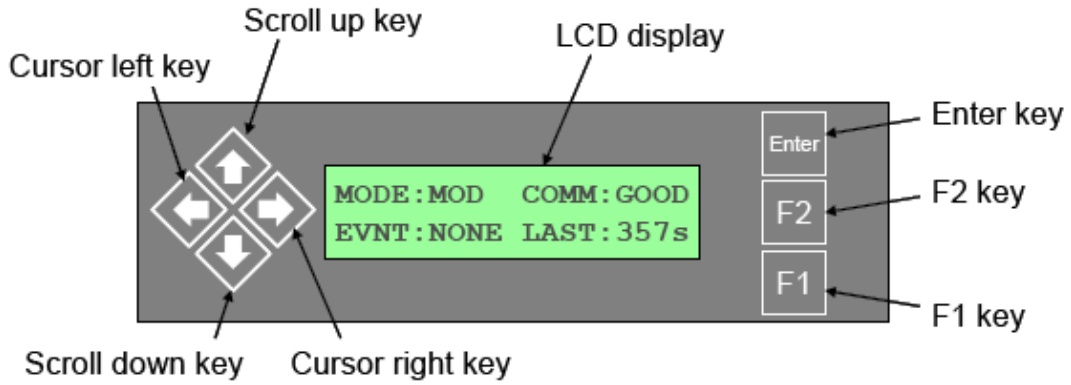
Electrical Specifications:

- 8 Relay Outputs, relay ratings: 24VDC@15A
- 10/100 Base T RJ45 Ethernet connector
- External 100-240VAC power supply: AC INPUT: 100 -240 VAC, DC OUTPUT: 12V, 6.6A, high power (80watt)

Physical Specifications:

- Dimensions: 8.116" x 8.868" x 2.558"
- 8 x 3 position screw terminals for relay connections
- 5mm/2.5mm barrel power jack
- Wall or shelf mount

Appendix B: CLIR Connection and using front-panel



1. Connect CLIR Box

a) Connect Ethernet to CLIR.
b) Plug in power adopter to CLIR.
c) Wait ~ 2 min. for CLIR boot-up. Check the LCD display. At first, you'll see "**COMM: BAD**"

2) Configure **Username** and **Password**

a) Enter username & password using keypad.
b) Press "F2". Scroll up/down until you see "username". The factory default is "test".
c) Press "Enter". Type your username assigned by scrolling up/down. You can move your cursor by pressing left/right arrow button. By pressing "F1", you can delete all characters to the right of the cursor. Once you complete entering your username, press "Enter" again.
d) Scroll up/down until you see "password". The factory default is usually "test".
e) Press "Enter". Type your password assigned by LBNL by scroll up/down. Once you complete, press "Enter" again.
f) Press "F2" to accept the setting and return to the main display Page.
g) Wait a few sec. to 1 min. for CLIR to establish communications with the Demand Response Automation Server (DRAS). The CLIR should respond with "**COMM: GOOD**" if the Ethernet connection is configured for DHCP or dynamic IP allocation. If it remains "**COMM: BAD**", check the network connection configuration explained previously in this document.

Appendix C: Example Shed Strategy

The CLIR receives signals from the utility indicating when a DR load reduction strategy should be activated. As described above in the section "Event Modes", these signals are reflected on the relays of the CLIR.

If the facility is signed up for the "AutoCPP" program, the event mode signals have the following meaning:

Event Mode Signal	Price Level
Normal	Normal
Moderate	3 X
High	5 X

- Upon receiving a "Moderate" event mode signal from Utility, the EMS will increase cooling space set-point by 2 deg F. Heating set-point remain unchanged; hot water valve shall not open as a result of the CPP event. Exhaust Fan 1 LED shall turn off

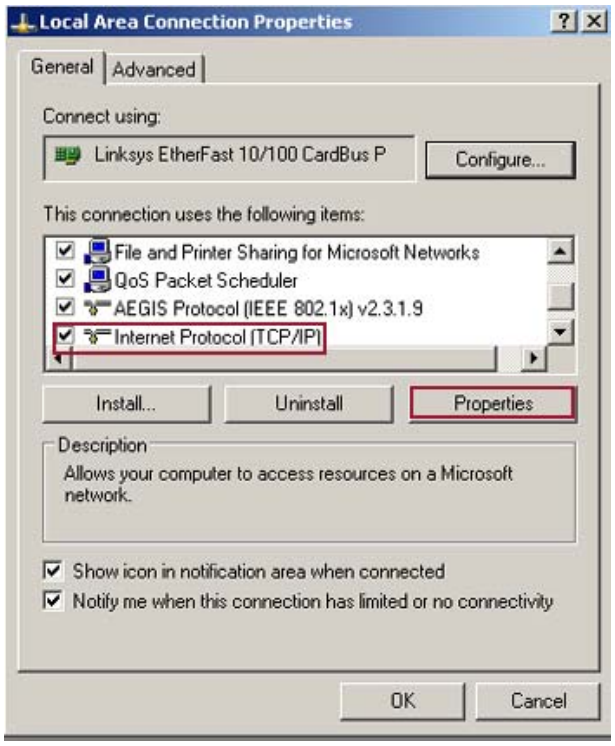
- Upon receiving a "High" event mode signal from Utility, the EMS will increase cooling space set-point an additional 2 deg F. Heating set-point remains unchanged; hot water valves shall not open as a result of the CPP event. Exhaust Fan 2 LED shall turn off, Exhaust Fan 1 shall remain off.

- Upon receiving a "Normal" event mode signal from Utility, the EMS will release space set-points back to its original setting. Exhaust Fans 1 and 2 shall incrementally turn on with a 30 second delay between fans.

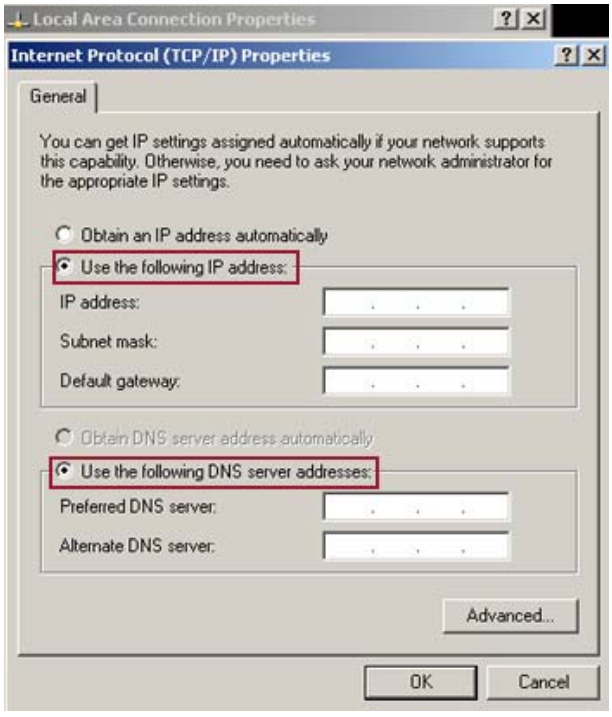
Appendix D.1: Windows IP Configuration

To configure laptop for "Static IP" and/or "Proxy Server" follow these instructions:

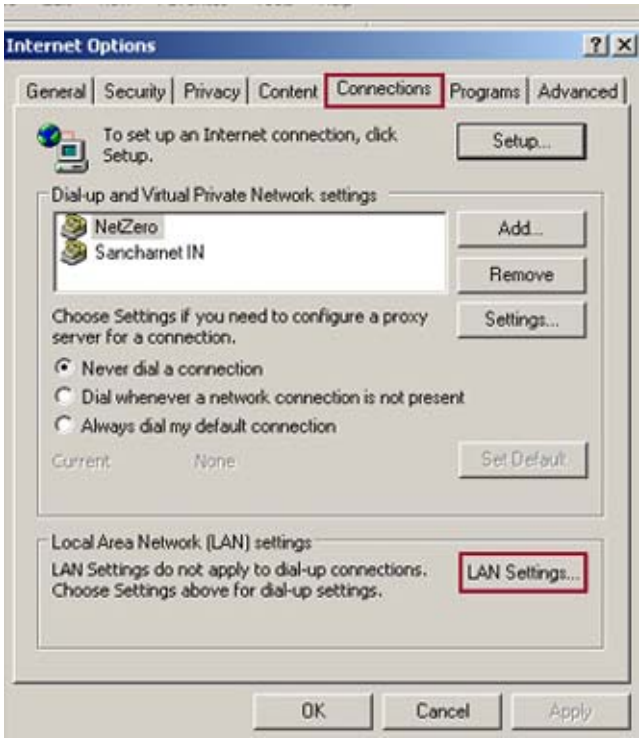
a) For static IP only – Start > Control Panel and select "Network Connections"
b) Right Click on " Local Area Connection" and select "Properties"
c) In the resulting window (below) select "TCP/IP" properties



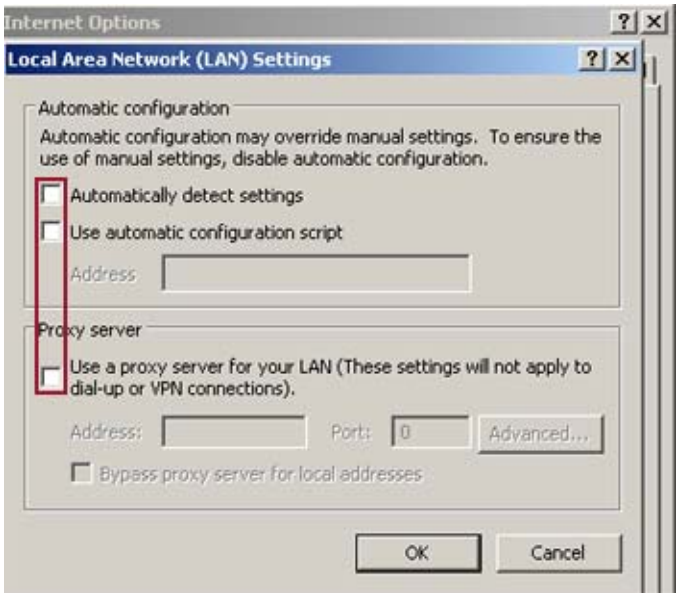
d) In the resulting TCP/IP properties window (below) enter the information obtained from IT personnel in "Use the following IP address" and enter these "Preferred and Alternate DNS Server" IP addresses – 206.13.28.12 and 206.13.31.12.



e) Open your Internet Explorer browser and select Tools > Internet Options. Under "Connections" (below) tab select "LAN settings."



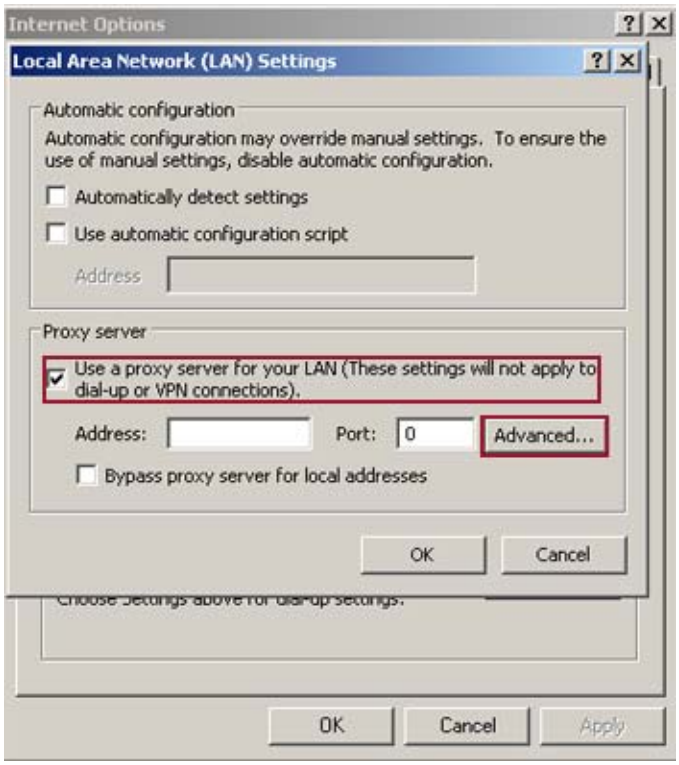
f) Under LAN settings window (below) make sure everything is unchecked.



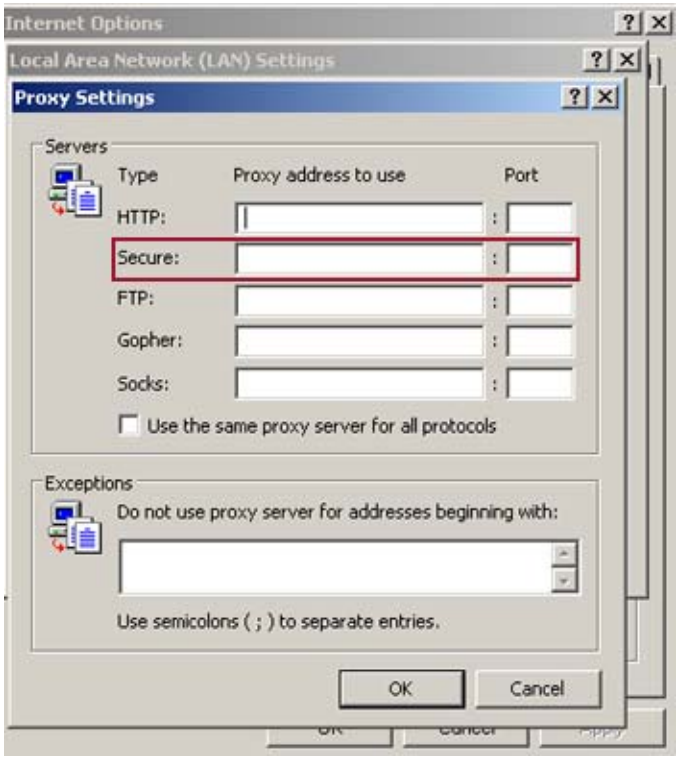
g) Apply the settings and check for the Internet connection. Proceed to synchronize laptop configuration with CLIR attributes, connect CLIR to Internet portal, confirm COMM: GOOD. If not, confirm the laptop settings to CLIR attributes and try again.

h) When facility uses "Proxy Server" for both Dynamic or Static IP address configurations, again in Internet Explorer browser, select Tools > Internet Options. Under "Connections" tab, select "LAN settings" and check "Use Proxy server" (below), enter the proxy IP

http://support.microsoft.com/kb/135982 as described in Appendix D.2.



i) In the resulting window (below) make sure that for HTTP the address is the same as previous and port is 8080. Optionally "Proxy Server" IP address for "Secure" server (SSL) can also be obtained.



Apply the settings and check for the Internet connection using the laptop.

Appendix D.2: Internet Explorer Proxy Configuration[1]

Internet Explorer 6.0
1. On the Tools menu in Internet Explorer, click Internet Options, click the Connections tab, and then click LAN Settings.
2. Under Proxy server, click to select the Use a proxy server for your LAN check box.
3. In the Address box, type the IP address of the proxy server.
4. In the Port box, type the port number that is used by the proxy server for client connections (by default, 8080).
5. You can click to select the Bypass proxy server for local addresses check box if you do not want the proxy server computer to be used when you connect to a computer on the local network (this may speed up performance).
6. Click OK to close the LAN Settings dialog box.
7. Click OK again to close the Internet Options dialog box.

Internet Explorer 5
1. Click Start, point to Settings, click Control Panel, and then double-click Internet.
2. Click the Connections tab, click LAN Settings, and then click to select the Use Proxy Server check box.
3. In the Address box, type the appropriate proxy server information, and use the following format: http://<address>
4. Click Advanced, and then type the appropriate proxy settings in the Servers area. Use the following syntax for the proxy settings: http://<address>:<port> [where <address> is the Web address of the proxy server, and <port> is the port number that is assigned to the proxy server.] For example, if the proxy server's address is "proxy.example.microsoft.com" and the port number is 80, the setting in the Proxy Server box should appear like this: http://proxy.example.microsoft.com:80

Important: If you use a backslash (\) instead of a slash (/) in the proxy server's address, the settings disappear from the Proxy Server box and Internet Explorer does not find the proxy server.

If you are using the Internet Protocol (IP) address of your proxy server, make sure not to type leading zeros. For example, use 130.25.0.1 instead of 130.025.000.001.

If you do not know the Web address or port number of the proxy server, contact your network administrator. Also, if there are any Web servers on the local network for which you want to bypass the proxy, type the appropriate host names in the Don't Use Proxy for These Addresses box. For example, if you do not want to use the proxy server to obtain access to the "example.com" Web server on your LAN, type example.com in the Don't Use Proxy for these addresses box.

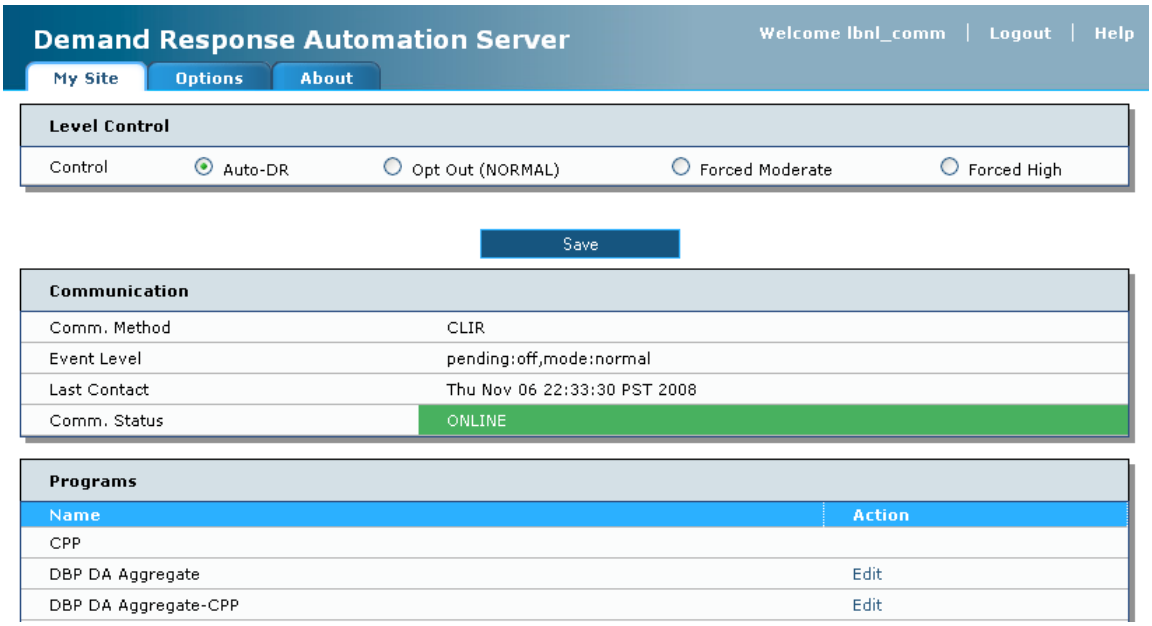
[1] http://support.microsoft.com/kb/135982

Appendix E: DRAS Relay Test Procedure

Once installation is completed, it is useful to change the event mode signal to confirm the EMCS has programmed and wired to the CLIR correctly. To do this:

1. Login to the DRAS facility manager UI using the provided username and password:

2. On the facility manager "My Site" tab shown below, select the "Forced Moderate" and "Forced High" control settings and confirm the CLIR and EMCS reacts appropriately and the "Last Contact column shows current timestamp. Note that you must click the "Save" button after selecting the control setting for it take affect.



3. Make sure switch the control setting back to "Auto-CPP" when the test is completed.

Note: Under "Options" tab it's recommended the initial password be changed and known only to the Facility Manager. Any change in password on "My Site" page has to be replicated on CLIR; otherwise CLIR will not communicate to DRAS.

Please contact the program operator to test event pending relay in CLIR.

Appendix F: CLIR Troubleshooting Guide

Problem Type	Possible Reason	Resolution Used	Future Mitigation
Endpointhost "*.openadr.com" does not work at facility	Wrong configuration of local network's access restrictions or network policy	TC had to use the IP format of the endpointhost instead of DNS "*.openadr.com".	Better coordination between Facility IT and TC to obtain accurate information for "CLIR Networking Worksheet."
Cannot change the Endpointhost field on CLIR	Older CLIR software did NOT have built-in functionality to change this setting using front-panel	Required logging to CLIR via SSH to change the settings manually in the configuration file.	UPDATE CLIR software version (2.4.2 or higher) that could be edited by CLIR front-panel
CLIR hangs after reboot	CLIR fails to restart due to Ethernet/LAN cable attached	TC resolved by disconnecting Ethernet/LAN cable before reboot.	Reboot CLIR after disconnecting Ethernet/LAN cable or place CLIR on Uninterruptible Power Supply (UPS).
Monthly generator maintenance causes power outage and subsequent hang to CLIR.	CLIR fails to restart due to Ethernet/LAN cable attached.	TC resolved by placing the CLIR on an UPS.	Refer Above
CLIR does not complete the boot sequence	Pre-boot eXecution Environment (PXE) image loads during DNS resolution	1. Add CLIR MAC/IP to PXE blacklist 2. Use static IP setup (no DNS)	RESOLVED within future embedded HW DRAS clients OR as per resolution
CLIR's relay closures did not work properly	Third-party controls contractor used wrong relays on the CLIR (event pending signal is on Relay #1)	Right relay positions were used.	Refer to the CLIR/Application Guide for relay references and event pending and operation modes.
The CLIR’s relays failed to work at a facility	Faulty CLIR (relays broken or damaged during transport) relays.	Replace CLIR	Refer to the CLIR User Guide and carry extra CLIR and adapter to facility during installation/testing.
Test Event Pending relay closure	Works only when DR event is issued	No feature on DRAS to force event pending signal during testing.	RESOLVED by including forced event pending notification in new release of DRAS
CLIR not communicating to DRAS	Alternate DNS addresses then those hard-coded in the CLIR (blocked by a firewall)	Required logging to CLIR via SSH to change the settings manually in the configuration file.	Allow this field to be editable by CLIR front panel OR order a custom CLIR which points to different DNA servers specified by the facility.
CLIR not communicating to DRAS	Network set-up required static IP configuration and CLIR was not given a dedicated IP address on the local network.	Work with the IT manager to find a dedicated IP address and switch the CLIR to static IP mode.	Better coordination between Facility IT and TC to obtain accurate information for "CLIR Networking Worksheet."
CLIR doesn't communicate to DRAS after a network disruption	Older CLIR software had a bug that stopped a graceful reboot	Required manual reboot	UPDATE CLIR software version (2.4.2 or higher) that has reboot switch. Manual reboot will work too.

Appendix G: CLIR IT managers networking worksheet before visiting a facility.

CLIR NETWORKING WORKSHEET

Customer: _____
IT Contact: _____
[Name]
E-Mail: _____
Phone 1: _____
Phone 2: _____

REFERENCE 1
□ DHCP
□ No DHCP (Static IP Address):
IP Address: ____.____.____.____
Subnet Mask: ____.____.____.____
Default Gateway: ____.____.____.____
Preferred DNS [*]: ____.____.____.____
Alternate DNS [*]: ____.____.____.____

* Required for testing laptop at the facility, NOT CLIR.

REFERENCE 2
□ No Proxy Server
□ Proxy Server:
Proxy IP Address: ____.____.____.____
Proxy Port: _____

REFERENCE 3
□ Hosts on subnet have HTTPS access to the DRAS and to DNS servers 206.13.28.12, 206.13.31.12, and 206.13.29.12

DRAS hostname (TC should highlight the hostname, otherwise please confirm):
- PGE - pge.openadr.com
- SCE - sce.openadr.com
- SDG&E - sdge.openadr.com